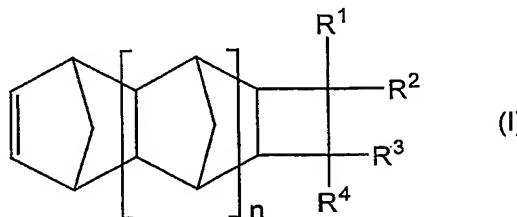


CLAIMS

What is claimed is:

1. A polymer comprising a repeat unit derived from
  - (a) at least one repeat unit derived from an ethylenically unsaturated compound having at least one fluorine atom covalently attached to an ethylenically unsaturated carbon atom; and
  - (b) at least one repeat unit derived from an ethylenically unsaturated compound having the structure:

10



wherein n is 0, 1, or 2;

R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> are independently H, OR<sup>5</sup>, halogen, alkyl or alkoxy of 1 to 10 carbon atoms, optionally substituted by halogen or ether oxygens, Y, C(R<sub>f</sub>)(R<sub>f'</sub>)OR<sup>5</sup>, R<sup>6</sup>Y or OR<sup>6</sup>Y;

Y is COZ or SO<sub>2</sub>Z;

R<sup>5</sup> is hydrogen or an acid-labile protecting group;

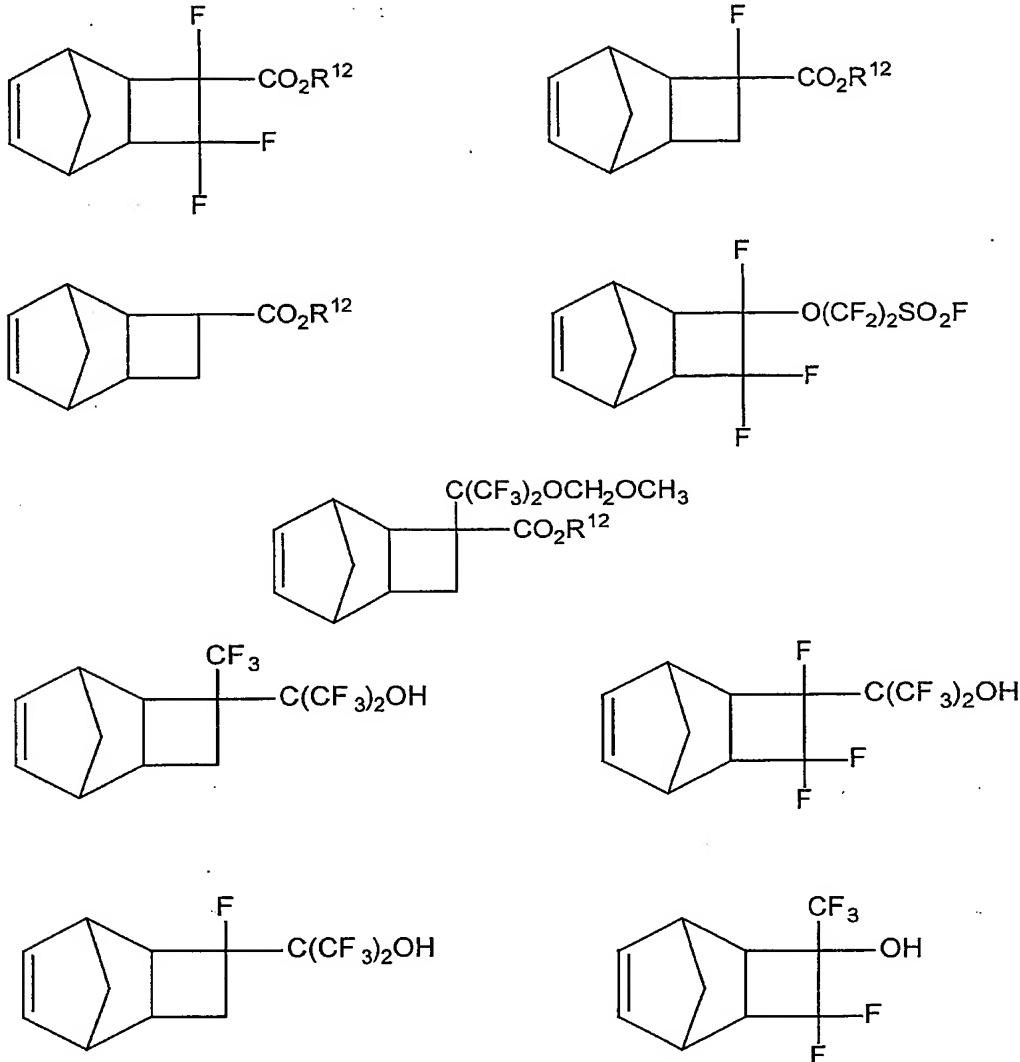
R<sub>f</sub> and R<sub>f'</sub> are the same or different fluoroalkyl groups of 1 to 10 carbon atoms or taken together are (CF<sub>2</sub>)<sub>m</sub> where m is 2 to 10;

R<sup>6</sup> is an alkylene group of 1 to 20 carbon atoms, optionally substituted by halogen or ether oxygen;

Z is OH, halogen, or OR<sup>7</sup>; and

R<sup>7</sup> is an alkyl group of 1 to 20 carbon atoms, with the proviso that at least one of R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> is Y, OR<sup>5</sup>, C(R<sub>f</sub>)(R<sub>f'</sub>)OR<sup>5</sup>, R<sup>6</sup>Y or OR<sup>6</sup>Y, and the proviso that if R<sup>1</sup> (or R<sup>3</sup>) is OH, R<sup>2</sup> (or R<sup>4</sup>) is not OH or halogen.

2. The polymer of Claim 1, wherein the compound having structure (I) is selected from the group consisting of:



wherein R<sup>12</sup> is an alkyl group of 1 to 20 carbon atoms.

5 3. The polymer of Claim 1, wherein the at least one ethylenically unsaturated compound having at least one fluorine atom covalently attached to an ethylenically unsaturated carbon atom is a fluoroolefin which comprises 2 to 20 carbon atoms.

10 4. The polymer of Claim 3, wherein the fluoroolefin is selected from the group consisting of tetrafluoroethylene; hexafluoropropylene; chlorotrifluoroethylene; vinylidene fluoride; vinyl fluoride; perfluoro-(2,2-dimethyl-1,3-dioxole); perfluoro-(2-methylene-4-methyl-1,3-dioxolane);

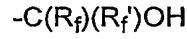
$\text{CF}_2=\text{CFO}(\text{CF}_2)_t\text{CF}=\text{CF}_2$ , wherein  $t$  is 1 or 2; and  $\text{R}_f''\text{OCF}=\text{CF}_2$  wherein  $\text{R}_f''$  is a saturated fluoroalkyl group of from 1 to 10 carbon atoms.

5. The polymer of Claim 4, wherein the fluoroolefin is tetrafluoroethylene.

5 6. The polymer of Claim 1, further comprising a unit containing a fluoroalcohol group or a protected fluoroalcohol group.

7. The polymer of Claim 6, wherein the fluoroalcohol group or the protected fluoroalcohol group is derived from at least one ethylenically unsaturated compound containing a fluoroalcohol group having the

10 structure:

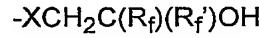


wherein  $\text{R}_f$  and  $\text{R}_f'$  are the same or different fluoroalkyl groups of from 1 to 15 10 carbon atoms or taken together are  $(\text{CF}_2)_m$  wherein  $m$  is 2 to 10.

8. The polymer of Claim 7, wherein  $\text{R}_f$  and  $\text{R}_f'$  are perfluoroalkyl groups.

9. The polymer of Claim 1, further comprising a unit containing a fluoroalcohol group having the structure:

20

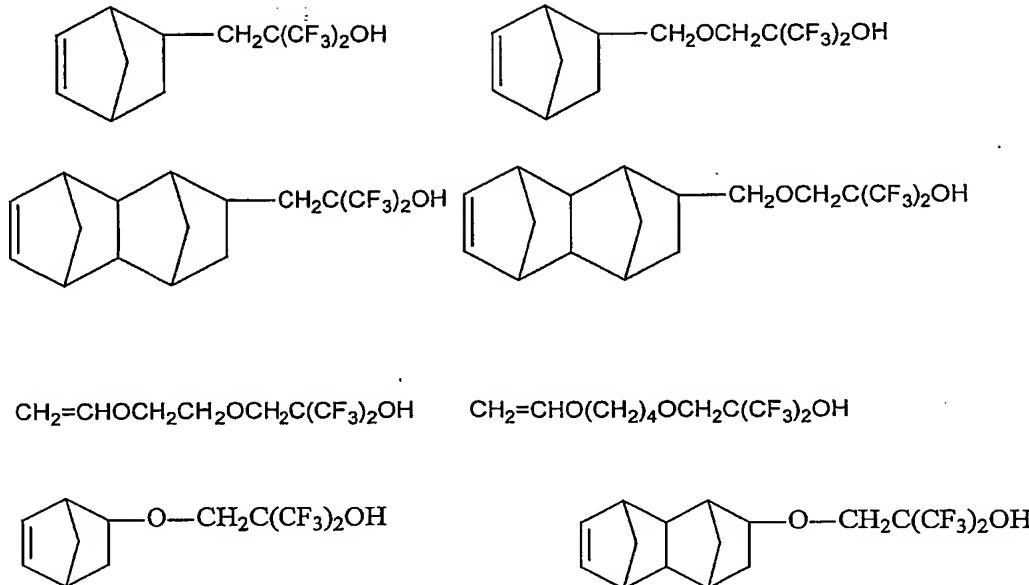


wherein  $\text{R}_f$  and  $\text{R}_f'$  are the same or different fluoroalkyl groups of from 1 to 10 carbon atoms or taken together are  $(\text{CF}_2)_m$  wherein  $m$  is 2 25 to 10; and  $\text{X}$  is an element from Group VA or Group VIA of the Periodic Table of the Elements.

10. The polymer of Claim 9, wherein  $\text{X}$  is selected from the group consisting of oxygen, sulfur, nitrogen and phosphorous.

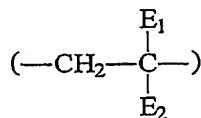
11. The polymer of Claim 10, wherein  $\text{X}$  is oxygen.

30 12. The polymer of Claim 7, wherein fluoroalcohol group or the protected fluoroalcohol group is derived from a monomer selected from the group consisting of:



5

13. The polymer of Claim 1 further comprising at least one acid-containing or protected acid-containing group of structural unit:



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wherein  $E_1$  is H or C<sub>1</sub>-C<sub>12</sub> alkyl;  $E_2$  is CO<sub>2</sub>E<sub>3</sub>, SO<sub>3</sub>E, or other acidic group; and E and E<sub>3</sub> are independently selected from the group of H, unsubstituted C<sub>1</sub>-C<sub>12</sub> alkyl, and heteroatom substituted C<sub>1</sub>-C<sub>12</sub> alkyl.

14. The polymer of Claim 13, wherein the heteroatom is selected  
15 from the group consisting of oxygen, nitrogen, sulfur, halogen and  
phosphorus atoms.

15. The polymer of Claim 14, wherein the heteroatom is oxygen, and the heteroatom substituted C<sub>1</sub>-C<sub>12</sub> alkyl further comprises a hydroxyl group.

20 16. The polymer of Claim 13, wherein the acid-containing or  
protected acid-containing group is derived from a carboxylic acid-  
containing monomer.

17. The polymer of Claim 13, wherein the acid-containing or protected acid-containing group is derived from a monomer selected from the group consisting of tert-butyl acrylate; 2-methyl-2-adamantyl acrylate; 2-methyl-2-norbornyl acrylate and acrylic acid.

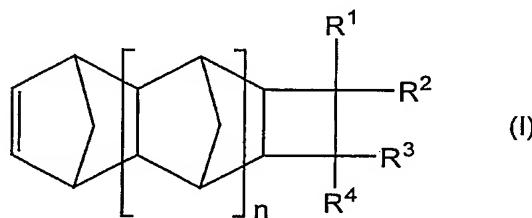
5 18. The polymer of Claim 1, further comprising at least one group derived from a polar monomer.

19. A photoresist composition comprising:

(1) a fluorine-containing polymer, wherein the fluorine-containing polymer comprises:

10 (a) at least one repeat unit derived from an ethylenically unsaturated compound having at least one fluorine atom covalently attached to an ethylenically unsaturated carbon atom; and

15 (b) at least one repeat unit derived from an ethylenically unsaturated compound having the structure:



wherein n is 0, 1, or 2;

20 R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> are independently H, OR<sup>5</sup>, halogen, alkyl or alkoxy of 1 to 10 carbon atoms, optionally substituted by halogen or ether oxygens, Y, C(R<sub>f</sub>)(R<sub>f</sub>')OR<sup>5</sup>, R<sup>6</sup>Y or OR<sup>6</sup>Y;

Y is COZ or SO<sub>2</sub>Z;

R<sup>5</sup> is hydrogen or an acid-labile protecting group;

25 R<sub>f</sub> and R<sub>f</sub>' are the same or different fluoroalkyl groups of 1 to 10 carbon atoms or taken together are (CF<sub>2</sub>)<sub>m</sub> where m is 2 to 10;

R<sup>6</sup> is an alkylene group of 1 to 20 carbon atoms, optionally substituted by halogen or ether oxygen;

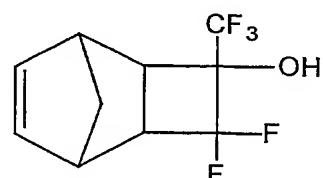
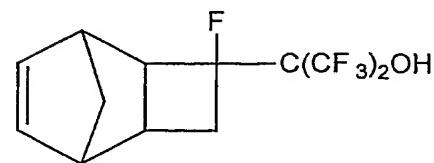
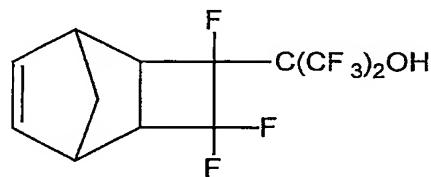
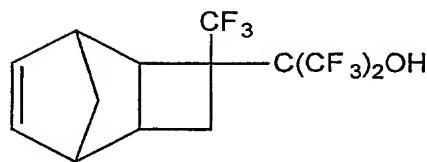
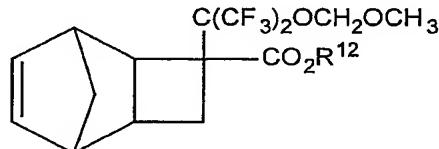
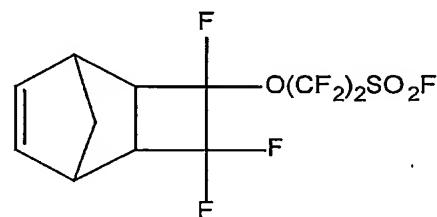
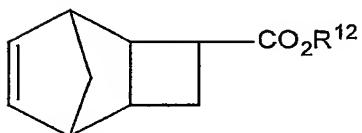
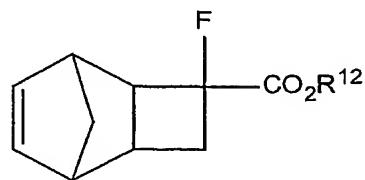
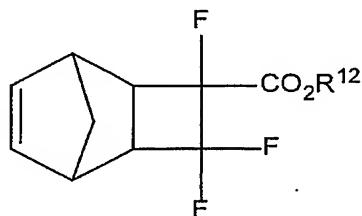
Z is OH, halogen, or OR<sup>7</sup>; and

30 R<sup>7</sup> is an alkyl group of 1 to 20 carbon atoms, with the proviso that at least one of R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> is OR<sup>5</sup>, Y, C(R<sub>f</sub>)(R<sub>f</sub>')OR<sup>5</sup>, R<sup>6</sup>Y or OR<sup>6</sup>Y,

and the proviso that if R<sup>1</sup> (or R<sup>3</sup>) is OH, R<sup>2</sup> (or R<sup>4</sup>) is not OH or halogen;  
and

(2) a photoactive component.

20. The photoresist composition of Claim 19, wherein the  
5 monomer having structure (I) in the fluorine-containing polymer is selected  
from the group consisting of:



10

wherein R<sup>12</sup> is an alkyl group of 1 to 20 carbon atoms.

21. The photoresist composition of Claim 19, wherein (a) is a fluoroolefin comprising 2 to 20 carbon atoms.

22. The photoresist composition of Claim 21, wherein the fluoroolefin is selected from the group consisting of tetrafluoroethylene; 5 hexafluoropropylene; chlorotrifluoroethylene; vinylidene fluoride; vinyl fluoride; perfluoro-(2,2-dimethyl-1,3-dioxole); perfluoro-(2-methylene-4-methyl-1,3-dioxolane);  $CF_2=CFO(CF_2)_tCF=CF_2$ , wherein t is 1 or 2; and  $R_f''OCF=CF_2$ , wherein  $R_f''$  is a saturated fluoroalkyl group of from 1 to 10 carbon atoms.

10 23. The photoresist composition of Claim 22, wherein the fluoroolefin is tetrafluoroethylene.

24. The photoresist composition of Claim 19, wherein the fluorine-containing polymer further comprises a unit containing a fluoroalcohol group or a protected fluoroalcohol group.

15 25. The photoresist composition of Claim 24, wherein the fluoroalcohol group or the protected fluoroalcohol group is derived from at least one ethylenically unsaturated compound containing a fluoroalcohol group having the structure:



wherein  $R_f$  and  $R_f'$  are the same or different fluoroalkyl groups of from 1 to 10 carbon atoms or taken together are  $(CF_2)_m$  wherein m is 2 to 10.

26. The photoresist composition of Claim 25, wherein  $R_f$  and  $R_f'$  25 are perfluoroalkyl groups.

27. The photoresist composition of Claim 19, wherein the fluorine-containing polymer further comprises a fluoroalcohol group having the structure:

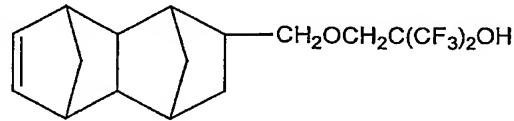
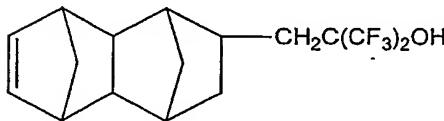
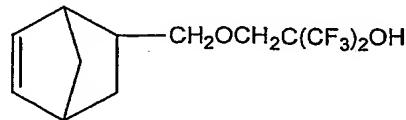
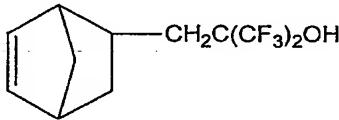


wherein  $R_f$  and  $R_f'$  are the same or different fluoroalkyl groups of from 1 to 10 carbon atoms or taken together are  $(CF_2)_m$  wherein m is 2 to 10; and X is an element from Group VA and VIA of the Periodic Table of the 35 Elements.

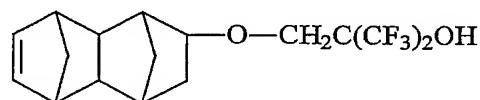
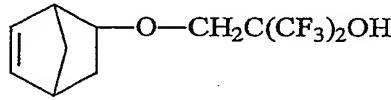
28. The photoresist composition of Claim 27, wherein X is selected from the group consisting of oxygen, sulfur, nitrogen and phosphorous.

29. The photoresist composition of Claim 28, wherein X is oxygen.

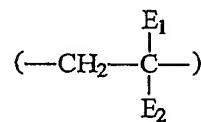
30. The photoresist composition of Claim 25, wherein the monomer containing the fluoroalcohol functional group or the protected fluoroalcohol group is selected from the group consisting of:



5       $\text{CH}_2=\text{CHOCH}_2\text{CH}_2\text{OCH}_2\text{C}(\text{CF}_3)_2\text{OH}$        $\text{CH}_2=\text{CHO}(\text{CH}_2)_4\text{OCH}_2\text{C}(\text{CF}_3)_2\text{OH}$



10      31. The photoresist composition of Claim 19, wherein the fluorine-containing polymer further comprises at least one acid-containing or protected acid-containing group of structural unit:



15

wherein  $\text{E}_1$  is H or  $\text{C}_1\text{-C}_{12}$  alkyl;  $\text{E}_2$  is  $\text{CO}_2\text{E}_3$ ,  $\text{SO}_3\text{E}$ , or other acidic group; and  $\text{E}$  and  $\text{E}_3$  are independently selected from the group of H, unsubstituted  $\text{C}_1\text{-C}_{12}$  alkyl, and heteroatom substituted  $\text{C}_1\text{-C}_{12}$  alkyl.

20      32. The photoresist composition of Claim 31, wherein the heteroatom is selected from the group consisting of oxygen, nitrogen, sulfur, halogen and phosphorus atoms.

33. The photoresist composition of Claim 32, wherein the heteroatom is oxygen, and the heteroatom substituted C<sub>1</sub>-C<sub>12</sub> alkyl further comprises a hydroxyl group.

34. The photoresist composition of Claim 31, wherein the acid-  
5 containing or protected acid-containing group is a carboxylic acid-containing monomer.

35. The photoresist composition of Claim 34, wherein the acid-containing or protected acid-containing group is selected from the group consisting of tert-butyl acrylate; 2-methyl-2-adamantyl acrylate; 2-methyl-  
10 2-norbornyl acrylate and acrylic acid.

36. The photoresist composition of Claim 19, wherein the fluorine-containing polymer further comprises at least one group derived from a polar monomer.

37. The photoresist composition of Claim 19, wherein the  
15 photoactive component is a photoacid generator.

38. The photoresist composition of Claim 19, further comprising a dissolution inhibitor.

39. The photoresist composition of Claim 19, further comprising a solvent.

20 40. The photoresist composition of Claim 39, wherein the solvent is selected from the group consisting of an ether ester; a ketone; an ester; a glycol ether; a substituted hydrocarbon; an aromatic hydrocarbon; a fluorinated solvent and super critical CO<sub>2</sub>.

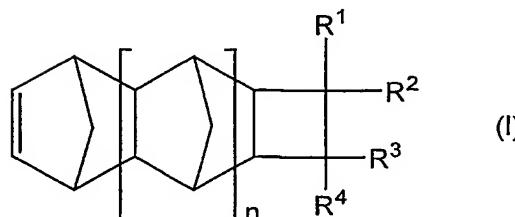
41. The photoresist composition of Claim 19, further comprising at  
25 least one additive selected from the group consisting of bases, surfactants, resolution enhancers, adhesion promoters, residue reducers, coating aids, plasticizers, and T<sub>g</sub> (glass transition temperature) modifiers.

42. A coated substrate comprising:

- (1) a substrate; and
- 30 (2) a photoresist composition comprising:
  - (a) a fluorine-containing polymer comprising a repeat unit derived from:
    - (i) at least one repeat unit derived from an ethylenically unsaturated compound having at least one fluorine atom covalently attached to an ethylenically unsaturated carbon atom; and

(ii) at least one repeat unit derived from an ethylenically unsaturated compound having the structure:

5



wherein  $n$  is 0, 1, or 2;

10  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  are independently H,  $OR^5$ , halogen, alkyl or alkoxy of 1 to 10 carbon atoms, optionally substituted by halogen or ether oxygens,  $Y$ ,  $C(R_f)(R'_f)OR^5$ ,  $R^6Y$  or  $OR^6Y$ ;

$Y$  is  $COZ$  or  $SO_2Z$ ;

$R^5$  is hydrogen or an acid-labile protecting group;

$R_f$  and  $R'_f$  are the same or different fluoroalkyl groups of 1 to 10 carbon atoms or taken together are  $(CF_2)_m$  where  $m$  is 2 to 10;

15  $R^6$  is an alkylene group of 1 to 20 carbon atoms, optionally substituted by halogen or ether oxygen;

$Z$  is OH, halogen, or  $OR^7$ ; and

20  $R^7$  is an alkyl group of 1 to 20 carbon atoms, with the proviso that at least one of  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  is  $Y$ ,  $OR^5$ ,  $C(R_f)(R'_f)OR^5$ ,  $R^6Y$  or  $OR^6Y$ , and the proviso that if  $R^1$  (or  $R^3$ ) is OH,  $R^2$  (or  $R^4$ ) is not OH or halogen; and

(b) a photoactive component.

43. The coated substrate of Claim 42, wherein the substrate is a microelectronic wafer.

25 44. The coated substrate of Claim 43, wherein the microelectronic wafer comprises a material selected from the group consisting of silicon, silicon oxide, silicon oxynitride, and silicon nitride.

45. A reaction product of quadrycyclane and a fluoroalkylbenzoate compound.

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